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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included.

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FINAL REPORT

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

STILLMAN 542.280

S-68

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U. S. Employment Service in
Cooperation with
Pennsylvania State Employment Service

U. S. DEPARTMENT OF LABOR

Washington , D. C.
October 1955

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY
FOR
STILLMAN 542.280

GATB

Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of sixty-three men employed by the Sun Oil Company, Philadelphia, Pennsylvania, as Stillman 4-55.030. The criterion consisted of rank-order ratings made by eight foremen. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes G - Intelligence, P - Form Perception, K - Motor Coordination and M - Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Stillman 542.280 - S-68

Table I shows for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Stillman 542.280.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for S-68

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	90	G	Part 3 Part 4 Part 6	85
P	CB-1-A CB-1-L	65	P	Part 5 Part 7	65
T	CB-1-G CB-1-K	65	K	Part 8	70
M	CB-1-M CB-1-N	65	M	Part 9 Part 10	65

Effectiveness of Norms

The data in Table IV indicate that 15 of the 20 poor workers, or 75 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 75 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 33 of the 38 workers who made qualifying test scores, or 87 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Stillman. 542.280.

II. Sample

Sixty-four men employed as Stillman. 542.280 by the Sun Oil Company, Philadelphia, Pennsylvania, were tested in September and October of 1954 with the General Aptitude Test Battery, B-1002A. All of the men who were tested had worked as Stillmen but had been promoted to Shift Foremen. They were classified as Foremen in order to have salary status and to make them part of management with responsibility beyond 8 hours of duty. However, they performed the duties of Stillman. Because of union difficulties, it was impossible to get a sample of men presently employed as Stillmen. There are 75 Still Foremen employed by the company. Two were excluded before testing because of physical disabilities, two were excluded at the request of the company and one was on extended leave. Six men were not available at the time of testing. One man was eliminated from the sample after testing because of a missing finger. Thus the final sample consists of 63 men.

The Sun Oil Company requires experienced workers for the job of Stillman. The workers must have spent at least five years in successive progression through the jobs of Utility Man, 2nd Class Helper and 1st Class Helper in a Petroleum Refinery. On-the-job training is continuously provided on an informal basis. Arrangements have also been made for the men to study Pennsylvania State University Extension or International Correspondence School courses in Petroleum Refining. The men are hired as Utility Men and work their way up to Stillman. Each Stillman supervises from one to eight Utility Men and 1st or 2nd Class Helpers.

Table II shows the means, standard deviations, ranges, Pearson product-moment correlations with the criterion, and the standard errors of correlation for age, education and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, Pearson Product-Moment Correlations with the Criterion (r), and the Standard Errors of Correlation (σ_r) for Age, Education, and Experience

Stillman . 542.280
N = 63

	M	σ	Range	r	σ_r
Age (years)	46.4	4.5	39-57	-.142	.123
Education (years)	10.1	2.4	6-16	.256	.119
Experience (months)	169.7	53.9	102-336	.148	.123

There is no significant correlations between age, education or experience and the criterion. The mean for age is relatively high. However, to enter the job and at least five years of experience are required to qualify for it. Therefore, workers are not likely to be very young when they enter this occupation. The experience data show that most of the workers in this sample have had extensive experience as Stillmen--none has had less than eight years of experience.

III. Job Description

Job Title: Stillman 542.280

Job Summary: Performs or directs others to perform the work entailed in the safe and continuous operation of one or a battery of stills in which crude or other oil is distilled to break it down into such products as gasoline, kerosene, lubricating oil, fuel oil, wax, tar, and a variety of solvents.

Work Performed: Operates a unit by the adjustment of knobs on the instrument panels of the automatic control equipment located in the unit control room. Receives specifications and instructions, both verbal and written, from foreman and sets knobs, valves and lever arms on the automatic regulators so that proper combination of flow temperature, pressure, vacuum, time catalyst, chemical and other process variables will result in the quality and quantity of product stipulated. Makes some simple arithmetic computations, occasionally figures a percentage or ratio and calls upon knowledge of and experience with plant operation in order to set controls properly to achieve desired result. Turns, presses or throws knobs, buttons and switchos on the control panel which control motor actuated valves located on the flow lines of the unit in order to build up or shut down the unit. Manually operates valves on the unit or auxiliary equipment controls under certain conditions and with certain equipment before, during and after unit operation. Inspects unit or section of unit after shutdown; enters still and uses experience and portable gages to make sure a condition exists that is safe from explosion, fumes, acid, heat and burns so that repair, maintenance, cleaners and other non-operating personnel may proceed to work in or around it.

Determines the presence and cause of trouble in automatic operation of a unit. Observes continuously the readings of the instruments so that temperatures, flows and pressures are always in balance according to specifications. Obtains check point readings from a meter connected with fixed type gages such as thermometers and pressure gages at hundreds of different points throughout the unit. Determines the location of trouble by using experience and knowledge to mediate between the indications on the control panel and the actual physical point of trouble in the unit. Action rapidly follows a trouble determination and in some instances requires immediate movement through the unit, up ladders or steps and along catwalks to manually operated valves controlling flows affected by the trouble. Determines the reason for the trouble which might be: leaks, blockages or faulty valves in the unit; failure of pumps, compressors, pre-heaters or other auxiliary equipment; volume, temperature, pressure or characteristics of flows entering the unit from another unit. Corrects condition causing trouble when this can be accomplished by routine methods not requiring repair or maintenance. May discover trouble by the automatic operation of signal lights on

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the control panel or the sounding of horns connected to the ceiling. In all conditions requiring even minor repair or maintenance to the furnace, that he may check condition and issue a work permit.

Performs related clerical work: Observes and records, at stated time intervals, the readings of all instruments on a daily log sheet. Makes some entries in a log book which is maintained on a permanent basis. Enters results of unit tests and laboratory tests on the daily log sheet. Prepares rolls, tapes, discs and charts of graph paper used in the recording instruments some of which require lines to be drawn, figures entered, starting points indicated and inserts in the instrument so that inking points are in the proper position to start recording. Reviews log sheet, log book and notes when starting to work so that continuity of operation will continue. Reads and studies diagrams and sketches when unit hook-ups are changed or new processes or equipment is added.

Patrols unit regularly to check operations: Directs the work and maintains close contact with Fireman, Gager, Pumpman, Topman, and other helpers. May perform or assist in the work of changing or regulating gas and oil burner heads in the furnaces, manually operating valves to change over pumps; oiling, greasing, packing, and standing watch at the small control boards in the furnace area, and compressor room. Makes sure that safety regulations are observed at all times and that the entire unit is always in safe operating condition.

Tests product at prescribed intervals: Opens bleeder valves located at certain points in stills, bottoms of tanks and on flow lines and withdraws samples of liquids or gases into containers designed for particular products. Weighs gas for specific gravity on an analytical scale and liquid for specific gravity with a hydrometer. Observes color of liquid product and compares with charts to determine whether processing is proceeding properly with respect to important factors measurable by color. Forwards those and other samples to laboratory at prescribed intervals during the day. Receives result of some of the laboratory analyses within a short time period the same day so that adjustment in process may be made immediately in order to prevent wastage of time and product.

IV. Experimental Battery

All of the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

The criterion consisted of supervisory ratings in rank order. There were eight foremen and each of the 63 workers were rated by at least two different foremen, with the exception of one man. Each of the eight raters evaluated as many men as possible, taking into consideration his knowledge of the person and the quality and quantity of work performed. The ratings are based solely on the ability of the men in the sample to work as Stillmen and do not include any evaluation of their ability as foremen. For computational purposes, the ratings were converted to linear scores and then averaged.

VI. Statistical and Qualitative Analysis

Table III shows the means, standard deviations, Pearson product-moment correlations with the criterion, and the standard errors of correlation for the aptitudes of the GATB.

The means and standard deviations of the aptitudes are comparable to general population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations (σ), Pearson Product-Moment Correlations with the Criterion (r) and the Standard Errors of Correlation (σ_r) for the Aptitudes of the GATB

Stillman 542.280
N = 63

Aptitudes	M	σ	r	σ_r
G-Intelligence	97.6	16.2	.387**	.107
V-Verbal Aptitude	96.0	16.3	.308*	.114
N-Humoral Aptitude	96.7	15.4	.225	.120
S-Spatial Aptitude	91.5	17.3	.434**	.102
P-Form Perception	80.8	16.2	.301*	.115
Q-Clerical Perception	90.7	12.8	.125	.124
K-Motor Coordination	86.5	17.2	.305*	.114
F-Finger Dexterity	79.0	16.0	.154	.123
M-Manual Dexterity	85.5	16.3	.113	.124

**Significant at the .01 level

*Significant at the .05 level

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Intelligence (G) - needed to comprehend thoroughly the functions and principles of refinery operation and to study and absorb new operating techniques. It is also required in order to make judgments and decisions that are necessary in daily operation and to locate and diagnose trouble when indicated by control panel.

Form Perception (P) - required to observe all the instruments and recordings continuously including graphic lines on charts, numbers, etc; to identify accurately needle point readings and graph deviations; and to prepare graph paper and charts indicating starting points, lining up, entering numbers and accurately inserting in instruments.

Clerical Perception (Q) - required to read and properly record hundreds of important and widely different items each day; to keep accurate tabular records on log sheet and in log book; and to relate quantities of numbers to symbols in order to write reports.

Motor Coordination (K) - required to adjust instruments while in motion.

Manual Dexterity (M) - required to manipulate knobs, buttons and switches on control panel; to place charts, tapes and graphs in the recording part of the instruments; to set control arms and needle points in proper recording positions and to turn wheels and valves on the still and auxiliary equipment.

The highest mean scores were obtained for Aptitudes G, N, V and S respectively, in decreasing order of magnitude. All of the aptitudes have standard deviations of less than 20 with Aptitude Q exhibiting the smallest standard deviation.

When $N = 63$, correlations of .324 and .248 are significant at the .01 level and the .05 level, respectively. Aptitudes G and S correlate significantly with the criterion at the .01 level of confidence. Aptitudes V, P and K correlate significantly with the criterion at the .05 level of confidence.

Aptitudes G, P, K and M were considered for inclusion in the test norms on the basis of the qualitative and quantitative factors cited above: all four of those aptitudes appear to be important in terms of job analysis data; Aptitudes G, P, and K show significant correlation with the criterion and, in addition, Aptitude G has the highest mean score.

Although there is some statistical evidence of significance for Aptitudes V, N, and S which warranted some preliminary consideration of these aptitudes for inclusion in the test norms, none of these aptitudes appeared to be as important as Aptitudes G, P, K, and M on the basis of the job analysis data. Therefore, they were not included in the final norms.

Consideration was also given to the inclusion of Aptitude Q in the test norms. However, since Aptitude Q did not appear to be as important on the basis of statistical results as Aptitudes G, P, and K, it was omitted from the test norms.

Tetrachoric correlations with the criterion were computed for several sets of trial norms consisting of various combinations of Aptitudes G, P, and K and G, P, K, and M. Although Aptitude M did not show significant correlation with the criterion, it tended to increase the selective efficiency of norms which included Aptitudes G, P, and K. Therefore, Aptitude M was included in the final test norms.

The cutting score for Aptitude G was set at one standard deviation unit below the mean and rounded to the higher adjacent five point score level. For Aptitudes P and K the minimum scores were set at one standard deviation unit below their respective mean scores and rounded to the nearest five point score levels. The cutting score for Aptitude M was set at one standard deviation unit below the mean and rounded to the lower adjacent five point score level. Setting cutting scores at these levels yielded the best selective efficiency for the norms and resulted in scores of 85, 65, 70, and 65, for Aptitudes G, P, K, and M, respectively.

VII.

Content Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion